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(54) **Disinfectant dry cleaning**

(57) Textile materials are cleaned and disinfected by tumbling in an organic solvent in the presence of a disinfectant bath whilst water is sprayed into a steam space above the solvent continuously simultaneously with the circulation of a hot air stream through the steam space and a cooler, the water being sprayed as a vapour or mist which serves to maintain a relative humidity of 70 to 100% and the total weight of water being 10 to 100% compared with the weight of the material being cleaned.

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SPECIFICATION

Disinfectant dry cleaning method

5 In the previously-customary methods of dry
cleaning material such as textiles, leather and
furs in a solvent bath without a disinfectant,
disinfecting of the said material is not
achieved; relevant tests show that, on the
10 contrary, the cleaning process can introduce
and distribute micro-organisms throughout the
material being cleaned.

The known methods of disinfectant dry
cleaning, which are formaldehyde or its deriv-
15 atives, work in the presence of cleaning inten-
sifiers (see Römpp 7th edition, volume 5,
page 2952) which are admixed with the sol-
vent bath, together with small quantities of
water. In this respect, to ensure good disin-
20 fecting without damaging the material to be
cleaned by creasing, matting or shrinking,
careful control both of the amount of water in
the liquor and of the relative air moisture or
humidity in the vapour space or steam space
25 above the bath is necessary. The latter should,
for example in the case of the single disinfect-
ant dry cleaning method described in the
"List of disinfectant agents and methods
tested and approved by the Federal Public
30 Health Department" (Issue of 1st June
1978), not fall below 90 percent.

In the journal "Reiniger—Wäscher" ("Cleaners—Washers"), issue No. 7/80, page
29, it is expounded that, with cleaning times
35 of 15 minutes during which the relative air
moisture in the steam space above the liquor
may not fall below 90 percent, the majority of
outer clothing worn nowadays felts or matts,
so that such cleaning methods are unsuitable
40 for commercial dry cleaning.

German Patent No. 21 08 991 has made
known a method which has in the meantime
been tested in practice and according to
which good cleaning effects can be achieved
45 in a hot air stream, without cleaning intensifi-
ers, only with organic solvent (for example
perchloroethylene) and water in a most finely
divided form, without disadvantageous impair-
ment (for example, felting) of the material
50 having to be feared.

From the point of view of hygiene, how-
ever, this procedure can be equated with the
customary cleaning processes, because micro-
organisms are neither killed off to an adequate
55 extent, nor is the propagation thereof pre-
vented. If an attempt is made to disinfect in
this method by adding formaldehyde, this is
not successful, because the initially-high rela-
tive air moisture drops to less than 70 percent
60 in a few minutes after the addition of water,
ensuing at the start of the cleaning, constrain-
edly through the condenser incorporated in
the system. Because there is considerable air
circulation in the steam space (or chamber) of
65 the machine, high relative air moisture can-

not, in practice, be achieved over a fairly long
period of time with the conventional dosing
equipment. A pre-requisite for a good disin-
fecting action of the formaldehyde upon the
70 dry cleaning is, however, a constantly high
relative air moisture of 80 to 90 percent.

We have surprisingly been found that, by
observing the follow method steps, both quali-
tatively high-grade cleaning and excellent di-
75 sinfecting effects are obtained:

1. During the entire cleaning process in a
conventional cleaning machine continuously
relative large amounts of water, up to 100
percent related to the weight of the material,
80 are sprayed in the form of vapour and/or fine
mist into the steam space above the cleaning
liquor.

2. By controlled hot air circulation one
prevents any damage, which would otherwise
85 perforce occur as a result of the substantial
additions of water mentioned under 1 above,
to the material to be cleaned by creasing,
shrinking or felting. The air circulating in the
machine is heated up by way of a heating
90 device and conducted through the steam
space above the cleaning liquor. From here it
is conducted, for condensation of entrained
vapours consisting of organic solvent and wa-
ter, by way of a cooler in a closed circuit back
95 to the heating device.

3. By a careful co-ordination of the spray-
ing-in-mentioned under 1, of water with the
hot air circulation mentioned under 2, at all
times the desired high relative air moisture,
100 optimum for disinfecting, is produced in the
steam space above the cleaning liquor.

4. The cleaning is performed without the
addition of cleaning intensifiers. The known
relationships between cleaning intensifiers and
105 water retention thus do not have to be
needed, which represents considerable simpli-
fication. Surprisingly, excellent cleaning ef-
fects have, nevertheless been achieved.

5. At the start of the cleaning process, a
110 suitable disinfectant is added.

The present invention provides, conse-
quently, a method of disinfectant dry cleaning
in which the material being cleaned is treated
without the addition of cleaning intensifiers, in
115 the presence of a disinfectant, with an organic
solvent bath, and subsequently the bath liquid
is pumped off and the material is spun, op-
tionally re-rinsed and dried in a hot air flow,
characterised in that, during the actual clean-
120 ing operation continuously 10 to 100 percent,
preferably 30 to 50 percent, water, related to
the weight of the material to be cleaned, is
sprayed in the form of vapour and/or a fine
mist into the steam space above the cleaning
125 liquor, and at the same time a hot air stream
is conducted in such a way, in a closed circuit
through the steam space and by way of a
subsequent cooling device, that during the
cleaning operation at all times a relative air
130 moisture of 70 to 100 percent, preferably 80

to 90 percent, prevails above the liquor.

Low aliphatic chlorohydrocarbons, for example perchloroethylene, are preferably used as organic solvents.

5 In carrying the method of the invention into effect, formaldehyde and its derivatives, in the form of formalene or hemiformalene, or chlorine or inorganic or organic substances with active chlorine as its effective component are
10 preferably used as disinfectant.

Depending on the manner in which the method is carried out, amounts of 0.005 to 0.5% formaldehyde, related to material weight, which corresponds to about 0.0005
15 to 0.05 percent related to the organic solvent, are sufficient. These amounts are sufficient to kill off test germs, namely: *Staphylococcus aureus* SG 511, *Bct. coli*, ATCC 8739, *Pseudomonas aeruginosa*, *Proteus vulgaris* and *Trichophyton mentagrophytes*.
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In order to eliminate residual amounts of formaldehyde on the treated material, post-cleaning treatment of the material being cleaned may be carried out with gaseous ammonia, in order to bind the residual formaldehyde as hexamethylenetetramine. Also re-treatment of the cleaned material can be effected with hydrogen peroxide in the liquor or
25 in the rinsing bath, in order to convert residual amounts of formaldehyde into formic acid. Similar re-treatment with a little hydrogen peroxide to eliminate residual amounts of chlorine can be effected at the end of the cleaning process, if chlorine or inorganic or
30 organic substances with active chlorine as effective ingredient are used as disinfectant. The treatment time is governed by practical requirements and lies in the range of 10 to 45 minutes, preferably 20 to 30 minutes. The disinfectant may be added with or shortly
40 after the first addition of water. During the cleaning process, a hot air stream is passed over the solvent bath which has a temperature of 20 to 60°C, preferably 30 to 40°C. This stream is introduced by way of a heating device into the steam space above the cleaning liquor and passes from there, for condensing entrained vapours, consisting of organic solvent and water, by way of a cooler around
45 a closed circuit back to the heating device. What is important is that the addition of water and the hot air circulation conducted by way of the cooler are so co-ordinated to one another that at all times 70 to 100 percent, preferably 80 to 90 percent, relative air moisture prevails in the steam space above the
50 cleaning liquor. In order to avoid any possible damage to the material being cleaned, at the end of the cleaning process, the hot air circulation is maintained without further spraying-in of water for a little longer, for example 3 minutes. Subsequently the bath liquid is pumped off, the material to be cleaned is
60 spun, possibly re-rinsed, and dried in the hot air stream.
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In the literature, reference is frequently made to smell obtrusion when disinfecting with formaldehyde. By virtue of the relatively small amounts of formaldehyde used in the described method of disinfectant dry cleaning,
70 only minimum amounts of formaldehyde adhere to the material being cleaned, at the end of the process, according to present experience. These amounts can, as already stated, easily be eliminated by steaming, by re-treatment with a little gaseous ammonia (with the formation of hexamethylenetetramine) or by oxidation into formic acid with, for example, hydrogen peroxide, at the end of the cleaning
75 process.
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Besides formaldehyde, chlorine is also a suitable disinfectant. This can be offered very simply in the form of commercially-available soda bleaching lye which contains about 15 percent active chlorine/litre. In order to avoid damage to the material being cleaned, maximum amounts of 0.3 percent active chlorine, related to the material weight, should not be exceeded.
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The invention is illustrated in more detail in the following example:-

A conventional cleaning machine is provided with a device for feeding steam into a steam space above cleaning liquor in the machine.
90 In the machine there is a blower with the aid of which air circulation can be caused. With this, air can be blown, by way of a heating device, into the steam space above the cleaning liquor and returned from there by way of a cooler (where entrained vapours, consisting of perchloroethylene and water, condense)
95 back to the heating device in a closed circuit. 25 kg of men's outer clothing, consisting of pure wool and mixtures of wool with customary synthetic fibres, are filled into the drum of the machine. Fixed to various items of clothing are small bags in which are contained tabs or pads carrying test germs. These consist of *staphylococcus aureus* SG 511, *Bct. coli*
100 ATCC 8739, *Pseudomonas aeruginosa*, *Proteus vulgaris* and *Trichophyton mentagrophytes*. After introduction of the articles of clothing into the machine, 130 litres of perchloroethylene are added, and the drum is driven rotationally. As soon as the articles of clothing are impregnated with perchloroethylene, the hot air circulation is switched on and water vapour (or steam) is sprayed in. Simultaneously with the first addition of steam, 400 ml of an aqueous solution, which contains 50 g of formaldehyde (0.2 percent related to the weight of the material), are sprayed in. In total, in the course of about 30 minutes continuously 12.5 kg of steam (50 percent related to material weight) are sprayed in, as a result of which a relative air moisture of 80 to 85 percent prevails in the steam space above the liquor. Through the co-ordination of the hot air circulation with the continuous addition of steam it is ensured that the indicated
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air moisture is constantly maintained. After the last addition of steam, the drum is caused to rotate, with continued hot air circulation, for a further 3 minutes. After that one pumps
5 and spins off the cleaning liquor, re-rinses with 130 litres of fresh distilled perchloroethylene for 4 minutes, spins off once more and dries the material in the hot air stream. After blowing-out with fresh air, the machine is
10 emptied and the small tabs or pads carrying the test germs are removed from the small bags fixed to the items of clothing. Re-cultures show that all of the test germs are dead. The cleaned and disinfected articles of clothing
15 are clean and neither felted nor shrunk.

CLAIMS

1. A disinfectant dry cleaning method in which material to be cleaned is treated without the addition of cleaning intensifiers, in the presence of a disinfectant, with an organic solvent bath, and subsequently the bath liquid is pumped off and the material is spun, optionally re-rinsed and dried in a hot air stream,
25 characterised in that, during the actual cleaning operation, continuously 10 to 100 percent water, related to the weight of the material to be cleaned, is sprayed in the form of vapour and/or a fine mist into the steam space above
30 the cleaning liquor, and at the same time a hot air stream is conducted in such a way, in a closed circuit through the steam space and via a subsequent cooling device, that during the cleaning operation at all times a relative
35 air moisture of 70 to 100 percent prevails above the liquor.

2. A cleaning method as claimed in claim 1, characterised in that low aliphatic chlorohydrocarbons are used as the organic solvent
40 bath.

3. A cleaning method as claimed in claim 1 or 2, characterised in that formaldehyde and/or chlorine and/or inorganic or organic substances containing active chlorine as its
45 active component, is used as disinfectant.

4. A disinfectant dry cleaning method as claimed in claim 1 and substantially as herein described by way of example.

5. Material which has been dry cleaned by
50 the method of any of claims 1 to 4.